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(54) Schuss knitted netting

(57) A knitting machine for knitting polyolefin ribbons into netting with longitudinal and lateral ribbons (20,18) is disclosed. The machine includes a plurality of knitting needles and a flat surface trick plate (22), the polyolefin ribbons forming the lateral ribbons (18) traverse the flat surface of the trick plate between adjacent needles along a straight line to define a lateral ribbon (18) of a calculated length and the trick plate (22) includes at least one corrugation (24) defining a curved surface of sufficient curvature so that when a polyolefin ribbon that is formed into the lateral ribbon (18) travels over the curvature, an actual lateral ribbon length that is at least 10% greater than the calculated ribbon length is produced.

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Description

[0001] This invention relates to knitted netting, and more particularly, to knitted netting as is used in wrapping, e.g. loads on pallets and bales of agricultural products. More particularly, the invention relates to knitted netting used in wrapping wherein the knitted netting is designed to minimise the transverse shrinkage of the netting.

[0002] Figure 1 of the accompanying drawings shows a prior art knitted Raschel netting 10 including schuss ribbons 12 and franze ribbons 14 of the type described in US Patent No. 5104714. Because of the triangular pattern in the knitted netting, all Raschel netting becomes narrower when pulled lengthwise. For example, when wrapping a pallet with conventional Raschel netting, when the netting is stretched about 60%, the netting may change in width from 50cm to about 25cm. When a longitudinal force is applied to the knitted netting, the franzes become longer. The longer the franze gets, the longer the schuss must be to maintain the same netting dimensions. However, up to a certain degree of elongation, the schuss does not extend because the schuss tends to straighten rather than elongate. The straighter the schusses, the smaller the distance between franzes, and the narrower the netting becomes resulting in transverse shrinkage of the knitted netting.

[0003] Transverse shrinkage has been inherent in Raschel knitted netting for as long as machines to produce such knitted netting have existed. It is well known that conventional Raschel netting becomes narrower even while being knitted on Raschel knitting machines. For example, if 48" Raschel knitted netting is desired, about 50" netting is knitted because the netting becomes narrower by about 2" between the knitting and the winding zones.

[0004] When a constant netting width is needed, the width can be regulated by changing the schuss tension in the knitting machine. The producers of knitted netting machines provide a facility on their machines to regulate the netting width, which depends on many factors including the type of material, temperature, ribbon dimensions, knitting tension, and knitting pattern. The knitting machine producers are aware that netting shrinkage is inherent in Raschel knitted netting. Such producers are also aware that increased tension on the schuss creates a narrower netting and loosened tension on the schuss prevents narrowing to some degree. Changing the schuss tension, however, is insufficient to fully overcome transverse shrinkage in knitted netting.

[0005] US patent No. 4781291 acknowledges that a problem with Raschel knitted netting is that it shrinks in overall width when pulled lengthwise due to the geometric pattern of the knitted netting and proposes a netting of square openings, instead of Raschel triangles, to solve the problem. By having transverse strands perpendicular to the longitudinal strands, creating rectangular openings instead of triangular, transverse shrinkage is overcome.

[0006] Accordingly, there is a need in the art for a knitted netting which does not shrink at all during the production process. Further, there is a need in the art for a knitted netting that maintains its full width during production and may also be widened to more than its full production width.

[0007] With the foregoing in mind, the Modified Schuss Knitted Netting of the present invention provides a "modified" schuss relative to the schuss of conventional knitted netting. A modified schuss is a schuss whose length is as long as is desired, which is in excess of and distinct from conventional knitted netting with schuss loosened only to the maximum permitted by the knitting machine.

[0008] Accordingly, the present invention provides a knitted netting which includes longitudinal polyolefin ribbons and lateral polyolefin ribbons knitted with the longitudinal polyolefin ribbons to form knitted netting, at least one of said lateral polyolefin ribbons of the knitted netting have an actual schuss length more than 110% of a calculated schuss length for the knitted netting.

[0009] The invention further provides a cylindrical bale of agricultural crops wrapped in a knitted netting having longitudinal polyolefin ribbons and lateral polyolefin ribbons knitted with the longitudinal polyolefin ribbons to form knitted netting, the lateral polyolefin ribbons of the knitted netting having an actual schuss length more than 110% of a calculated schuss length for the knitted netting and the knitted netting extending about the circumference and over the edge of the cylindrical body enclosing and maintaining the crops therein.

[0010] Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a prior art knitted Raschel netting;
Figure 2 shows a knitted Raschel netting in accordance with the invention;
Figure 3a illustrates a roll of knitted netting;
Figure 3b illustrates a partially unrolled roll of knitted netting;
Figure 3c illustrates calculation of schuss length for knitted netting;
Figure 4a shows a corrugated trick plate for use in a knitting machine;
Figure 4b shows a single round piece for use with a corrugated trick plate;
Figure 5 shows a shrinkage/elongation curve for conventional knitted netting;
Figure 6 shows a shrinkage/elongation curve for knitted netting according to the invention;
Figure 7 shows a hay bale wrapped with conventional knitted netting; and
Figure 8 shows a hay bale wrapped with knitted netting according to the invention.

[0011] Figure 2 shows a knitted Raschel netting 16 in

accordance with the invention which has a "modified" schuss 18 relative to the schuss of conventional knitted netting. The modified schuss has a length longer than the schuss length obtained when loosened to the maximum permitted by the knitting machine. For example, a knitted netting including a modified schuss that is about 30% longer than the prior art schuss provided by the knitting machine becomes narrower by about 12% at 60% elongation of the knitted netting during wrapping, while the same netting without modified schuss becomes narrower by about 50% at 60% elongation.

[0012] The schuss is created by moving the schuss ribbon between two needles while the netting being knitted moves longitudinally in the knitting machine. Because of the two directional movement, the schuss 18 creates legs of a triangle while the franze 20 creates a triangle base. The tension of the schuss can be adjusted, but is limited and can only produce schuss with an actual length less than 110% of the calculated length of the leg of the triangle created by moving the schuss ribbon between two needles at the longitudinal speed.

[0013] The preferred amount of elongation of the schuss length depends upon the particular netting application. For elastic pallet wrapping, the preferred actual schuss length is about 135% of the calculated schuss length for the netting. For conventional wrapping netting with an elongation at break of about 20%, a modified schuss is not needed because such netting only elongates about 1-3% in normal use and does not exhibit transverse shrinkage.

[0014] The characteristics of the Modified Schuss Knitted Netting of the present invention may be seen by comparing an actual schuss length of a given netting length with a calculated schuss length. Modified Schuss Knitted Netting of the invention has an actual schuss length more than 110% of the calculated schuss length. The suggested procedure for comparing actual schuss length with calculated schuss length is illustrated in Figures 3a and 3c and may be described as follows:

1) Measure the length (L) between the two extreme franzes on a roll of knitted netting as shown in Figure 3a. (The overall roll length is shown as O).

2) Divide the length (L) by the number of franzes minus one to define an average distance between two franzes (H).

3) Unroll some of the knitted netting and measure the length between 10 such distances (10A) and divide them by 10 to define an average length between two triangle legs (A) as shown in Figure 3b. This measurement should be performed while applying about 50g to the franzes on which the schuss will be measured.

4) Calculate the schuss (S) length between two triangle legs as shown in Figure 3c as follows:

$$S = 2\left(\sqrt{(A/2)^2 + H^2}\right)$$

5) Determine an actual schuss length for distance 10A by unrolling some of the knitted netting and transversely cutting the franzes and schusses. Take out the schuss between two franzes and measure the length of the schuss while flattening the schuss on a flat plate to determine the actual schuss length (ASL).

6) For Modified Schuss Knitted Netting of the invention, ASL will exceed 10S by more than 10%.

[0015] Existing Raschel knitting machines do not provide a facility for providing a modified schuss in accordance with the present invention. The maximum loosened schuss which can be knitted on these machines can at best widen the netting a little bit, but even so the netting will tend to narrow.

[0016] In order to create the modified schuss according to the invention and to overcome such knitting machine limitations, a corrugated trick plate as shown in Figure 4a may be incorporated into the knitting machine. The use of a conventional trick plate is illustrated, for example, in US patent No. 3646782. The corrugated trick plate includes a flat plate 22 providing corrugations 24 which force the schusses to traverse a longer distance as the schusses move between the knitting machine needles than would be traversed in a conventional knitting machine. The schusses cannot move in a straight line; the schusses must follow the curvature of the corrugated trick plate. Accordingly, when the knitted netting leaves the corrugated trick plate, the schuss length is longer than the original. The thicker the corrugations between needles on the flat plate, the longer the schusses that are produced.

[0017] Where an equal amount of schuss modification is needed over the complete netting width, a corrugated plate as described with respect to Figure 4a may be used. Where modified schuss is required only on particular schusses, a flat plate absent corrugations (not shown) may be used to produce a thicker area between particular needles. This can be achieved by attaching a round piece 26 to the flat plate by means of a screw or other suitable fastener. Round piece 26 is shown in Figure 4b.

[0018] With the Modified Schuss Knitted Netting it is not possible to regulate the netting width by increasing the schuss tension as was done in conventional knitted netting. When knitting with modified schuss, the width will always remain the same and will be a function of the number of needles and the distance between them. There will be no shrinking during the knitting process. The width in the Modified Schuss Knitted Netting can differ only in quantum amounts equivalent to the dis-

tance between needles.

[0019] It may be appreciated that there are many distinct advantages to the present invention. Insertion or removal of a single round piece is simple. Locating the right parts in the right place when different amounts of schuss modification are needed at different places across the netting is simplified, as a different thickness of the single round piece can be used.

[0020] It is important that when the same amount of schuss modification is needed over the netting width, a single corrugated trick plate (as shown in Figure 4a) may be used.

[0021] The amount of schuss modification created on the complete netting width can be varied to some degree by regulating the schuss tension. This is done by regulating the schuss tension on the existing machine. Only when a different amount of modified schuss across the netting width is needed would different single round pieces (distinguishable by their different thicknesses) be used.

[0022] It will be appreciated by those skilled in the art that the Modified Schuss Knitted Netting according to the invention provides many unexpected advantages over conventional knitted netting. In particular, the Modified Schuss Knitted Netting is somewhat stronger, perhaps because the schusses do not create radial stresses on the franzes as in conventional knitted netting. Comparing Figures 5 and 6, it will be appreciated that the slope of the shrinkage/elongation curve created by the

[0023] Modified Schuss Knitted Netting is a function of the amount by which the schuss is modified. A very small degree of shrinkage always occurs in the Modified Schuss Knitted Netting at the moment when longitudinal force is applied.

[0024] Comparing Figures 7 and 8, when wrapping a round hay bale by using Modified Schuss Knitted Netting wider than the bale, a considerable amount of over-edge coverage is achieved considering the number of franzes on the outside of the hay bale. (Note that in the Figures D1=D2, L1=L2, and D3>D2). Over-edge-wrapping of hay bales provides the advantage of increasing the covered area on both sides of the bale. Because the franze length would be reduced on the smaller diameter at the extremities, some folding or pleating would be expected to occur as the net spread over the edge. However, the amount of over-edge coverage has been found to be a function of the net elongation while wrapping and the amount of modified schuss. For example, if the circumference length of the last franze is x% shorter and the bale wrapping is performed with an x+1% stretch, then the last franze will create a 1% elongation. In this case, even if the shorter franze stretches only 1%, the schusses spread to their maximum length with respect to the length of the modified schuss. Therefore, the distance between the two franzes in this case is larger than the distance between the two needles on the machine. The netting merely does not shrink in width when wrapped around the bale (the distances between franzes remain nearly constant without narrowing), but on both sides of the bale, the distance between franzes becomes more than the distance between needles, due to radial forces that are created which spread the schusses to their maximum modified length.

[0025] In addition to the foregoing properties, the modified netting of the invention can also be widened to more than its original width, even where longitudinal force is applied on the netting. Such phenomenon is created on the peripheral portions of the bale as discussed above.

[0026] The present invention is applicable to all kinds of netting containing longitudinal franze and lateral schusses. Even in netting with horizontal schusses which create quadrant openings there will be an advantage if it is knitted with modified schuss.

[0027] Such netting usually does not shrink on its lengthwise direction; but without modified schuss it could not be widened to more than its original width. Further, the present invention is not limited to any particular material or kind of strands, tapes, monofilament, multifilament, or the like. Still further, it will be appreciated that a knitted netting may be produced with only some loosened schusses on both sides or at any place along the net width, the netting can be widened during wrapping process, at any predetermined area of the wrapped load, etc.

[0028] Knitted netting may also be produced with different amounts of schuss modification. If a given number of franzes are over the edge, by using higher schuss modification on those franzes would create higher coverage on both bale sides.

Claims

1. A knitting machine for knitting polyolefin ribbons into netting with longitudinal and lateral ribbons (20,18), the machine includes a plurality of knitting needles and a flat surface trick plate (22), the polyolefin ribbons forming the lateral ribbons (18) traversing the flat surface of the trick plate between adjacent needles along a straight line to define a lateral ribbon (18) of a calculated length, **characterised in that** the trick plate (22) includes at least one corrugation (24) defining a curved surface of sufficient curvature that when a polyolefin ribbon that is formed into the lateral ribbon (18) travels over the curvature, an actual lateral ribbon length that is at least 10% greater than the calculated ribbon length is produced.

2. The machine according to claim 1 **characterised in that** the trick plate (20) includes a plurality of corrugations (24).

3. The machine according to claim 1 wherein the curved surface is sufficiently curved so that when a

polyolefin ribbon that is formed into the lateral ribbon (18) travels over the curvature, an actual ribbon length that is at least 30% greater than a calculated ribbon length is produced.

4. The machine according to claim 1 wherein the curved surface is sufficiently curved so that when a polyolefin ribbon that is formed into the lateral ribbon (18) travels over the curvature, an actual ribbon length that is between 10% and 30% greater than a calculated ribbon length is produced.

5. A method of manufacturing knitted netting with a knitting machine having a flat trick plate (22) and a plurality of knitting needles, wherein lateral polyolefin ribbons (18) and longitudinal polyolefin ribbons (22) are supplied to the knitting machine and the lateral ribbons (18) traverse the flat surface of the trick plate (22) as a netting is knit, the netting having a plurality of lateral ribbons (18) each having a calculated ribbon length that is a function of the distance between adjacent knitting needles, **characterised in that** the flat surface trick plate (22) is modified to have at least one corrugated surface (26), and the at least one corrugated surface (26) has a curvature sufficient so that when the lateral ribbon (18) traverses the curvature between adjacent needles, the lateral ribbons (18) traverse a greater distance than occurs with a trick plate (22) lacking the corrugations, and passing the lateral ribbons (18) over the modified trick plate (22) as the netting is knit resulting in a netting that has at least one actual ribbon length that is at least 10% greater than the calculated ribbon length.

6. The method of claim 5 **characterised in that** the trick plate has corrugated surfaces located at the outer edges of the trick plate (22) and the modified lateral polyolefin ribbons (18) are formed along outside edges of said knitted netting.

7. The method of claims 5 or 6 **characterised in that** the at least one modified lateral ribbon (18) is formed to have an actual length that is between 10% and 30% greater than said calculated length.

8. The method of claims 5 or 6 **characterised in that** the at least one modified lateral ribbon (18) is formed to have an actual length that is at least 30% greater than said calculated ribbon length.

9. The method of claim 5 **characterised in that** the trick plate (22) has a plurality of corrugations so that a plurality of the lateral polyolefin ribbons (18) formed have an actual length that is at least 10% greater than said calculated ribbon length.

10. The method of claim 5 **characterised in that** the trick plate (22) has a plurality of corrugations so that a plurality of the lateral polyolefin ribbons (18) formed have an actual length that is between 10% and 30% greater than said calculated ribbon length.

11. The method of claim 7 **characterised in that** the plurality of modified lateral ribbons (18) are formed to have an actual length that is at least 30% greater than said calculated ribbon length.

12. The method of claim 5 **characterised in that** the trick plate (22) has a sufficient number of corrugations (24) so that all of the lateral polyolefin ribbons formed have an actual length that is at least 10% greater than said calculated ribbon length.

13. The method of claim 12 **characterised in that** all of the lateral polyolefin ribbons (18) of the knitted netting are formed to have an actual length that is at least 30% greater than said calculated ribbon length.

14. The method of claim 12 **characterised in that** all of the lateral polyolefin ribbons of the knitted netting are formed to have an actual length that is between 10% and 30% greater than said calculated ribbon length.

PRIOR ART

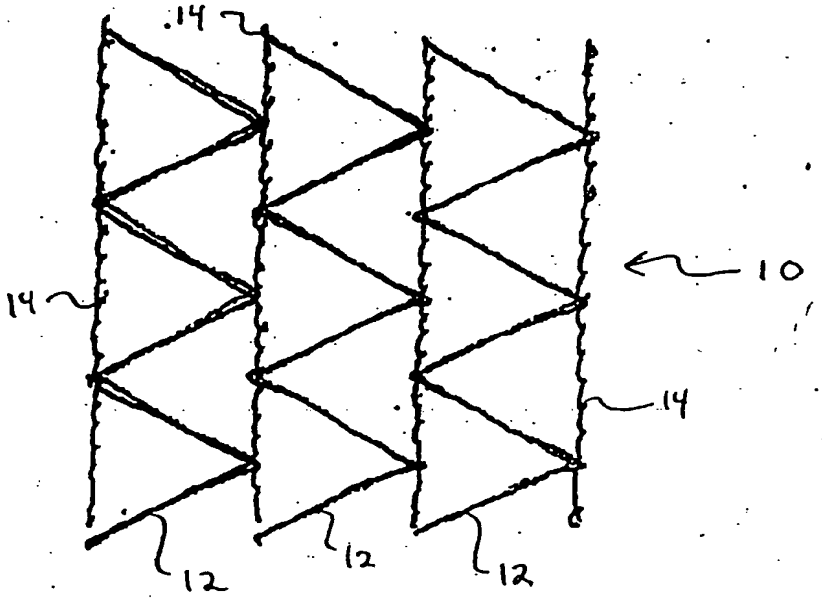


FIG. 1

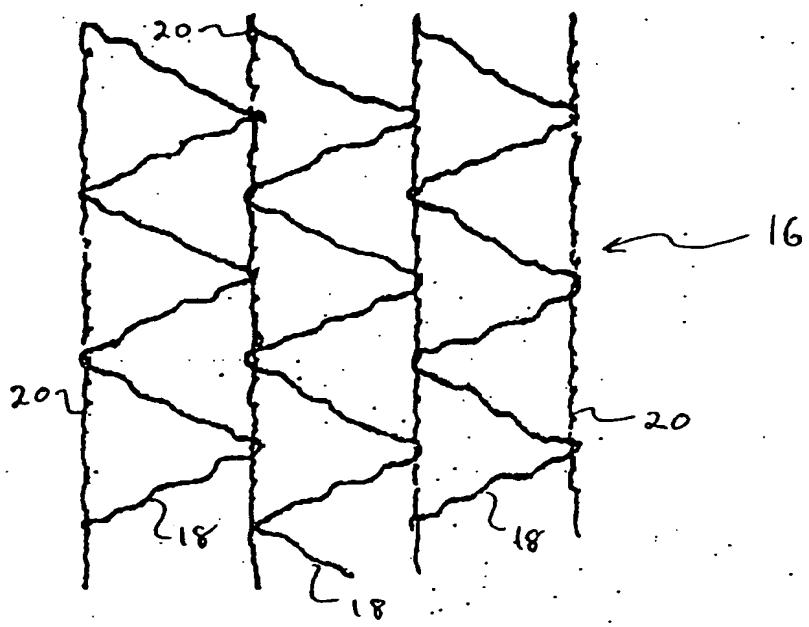


FIG. 2

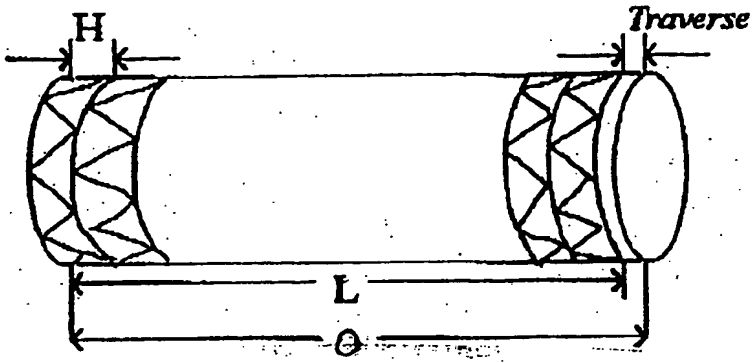


FIG. 3a

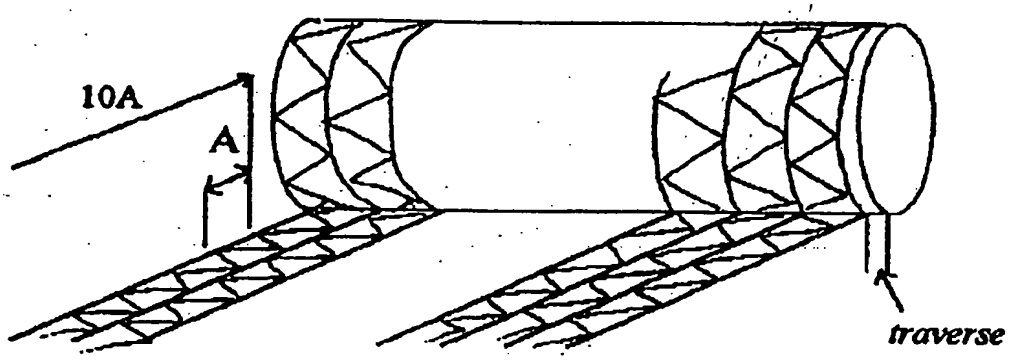


FIG. 3b

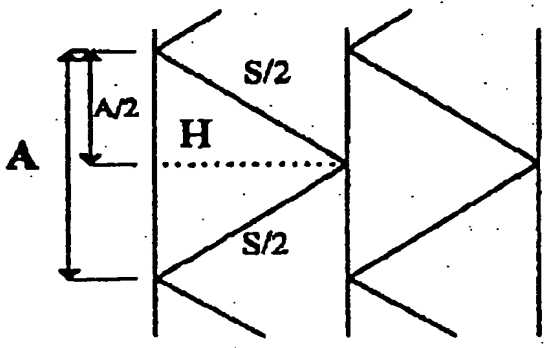


FIG. 3c

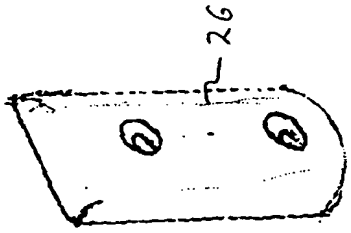


FIG. 4b

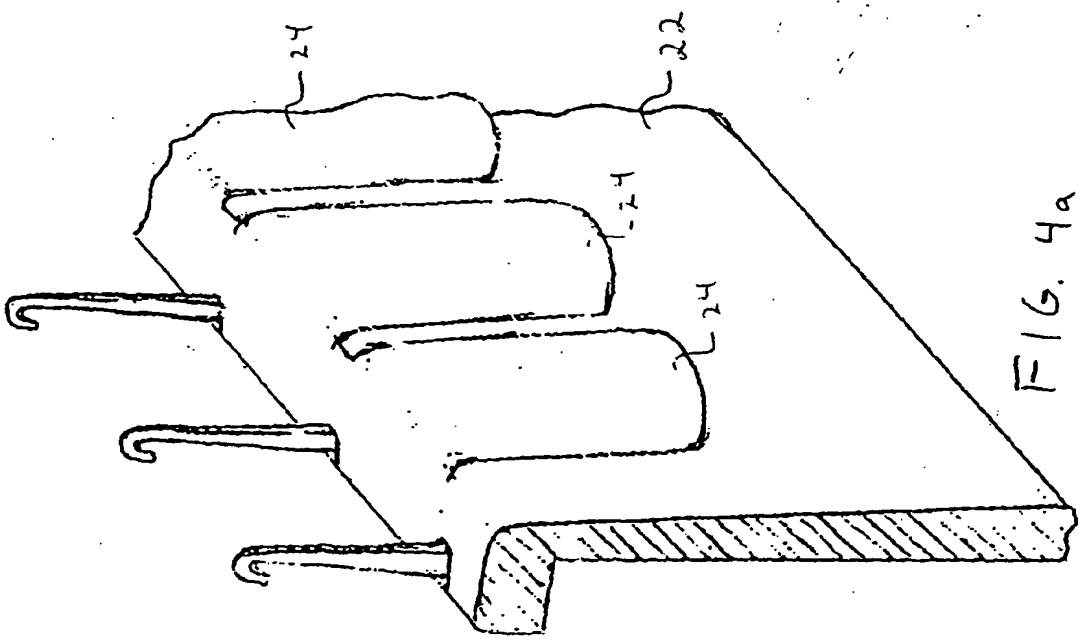


FIG. 4a

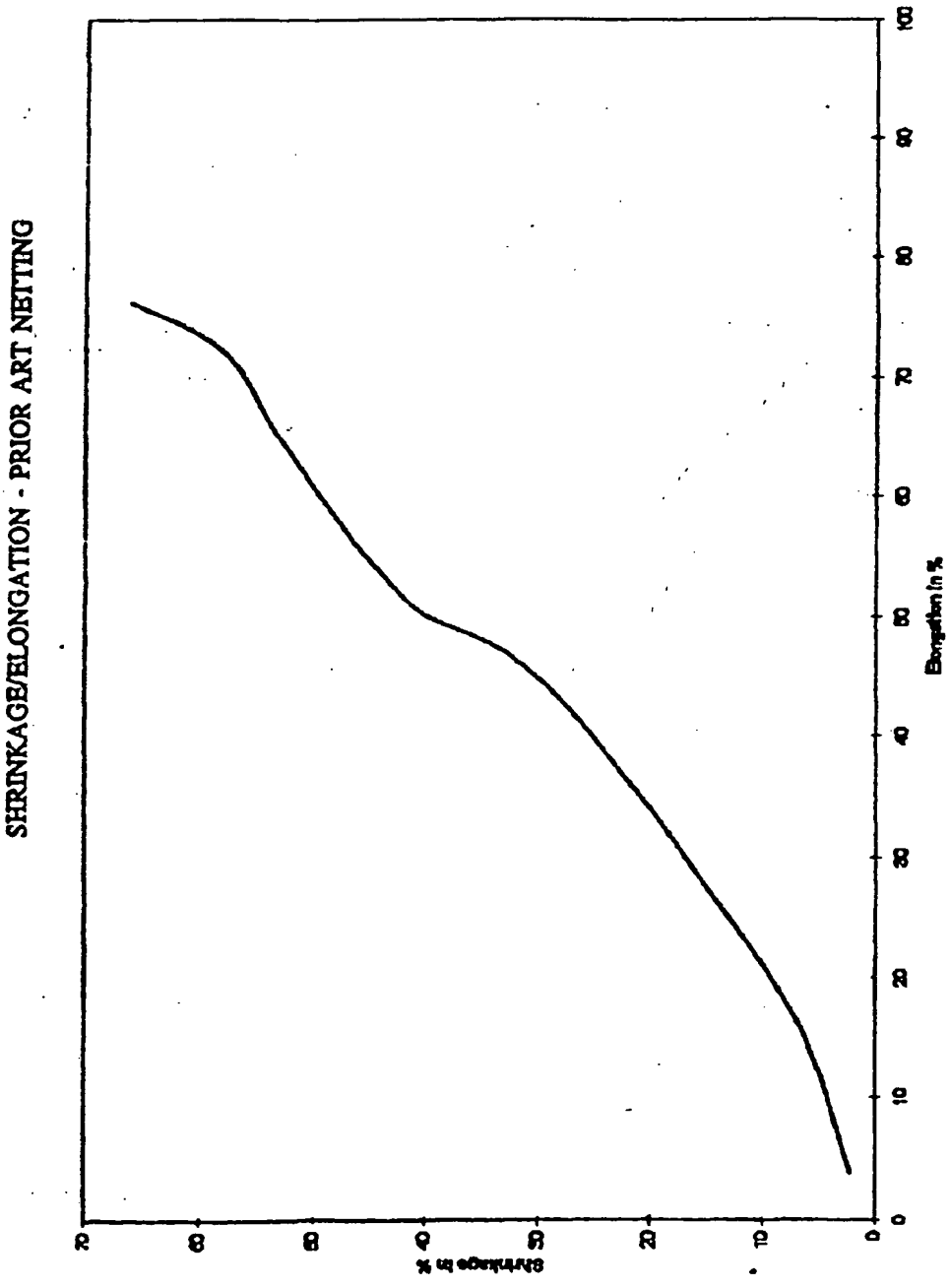
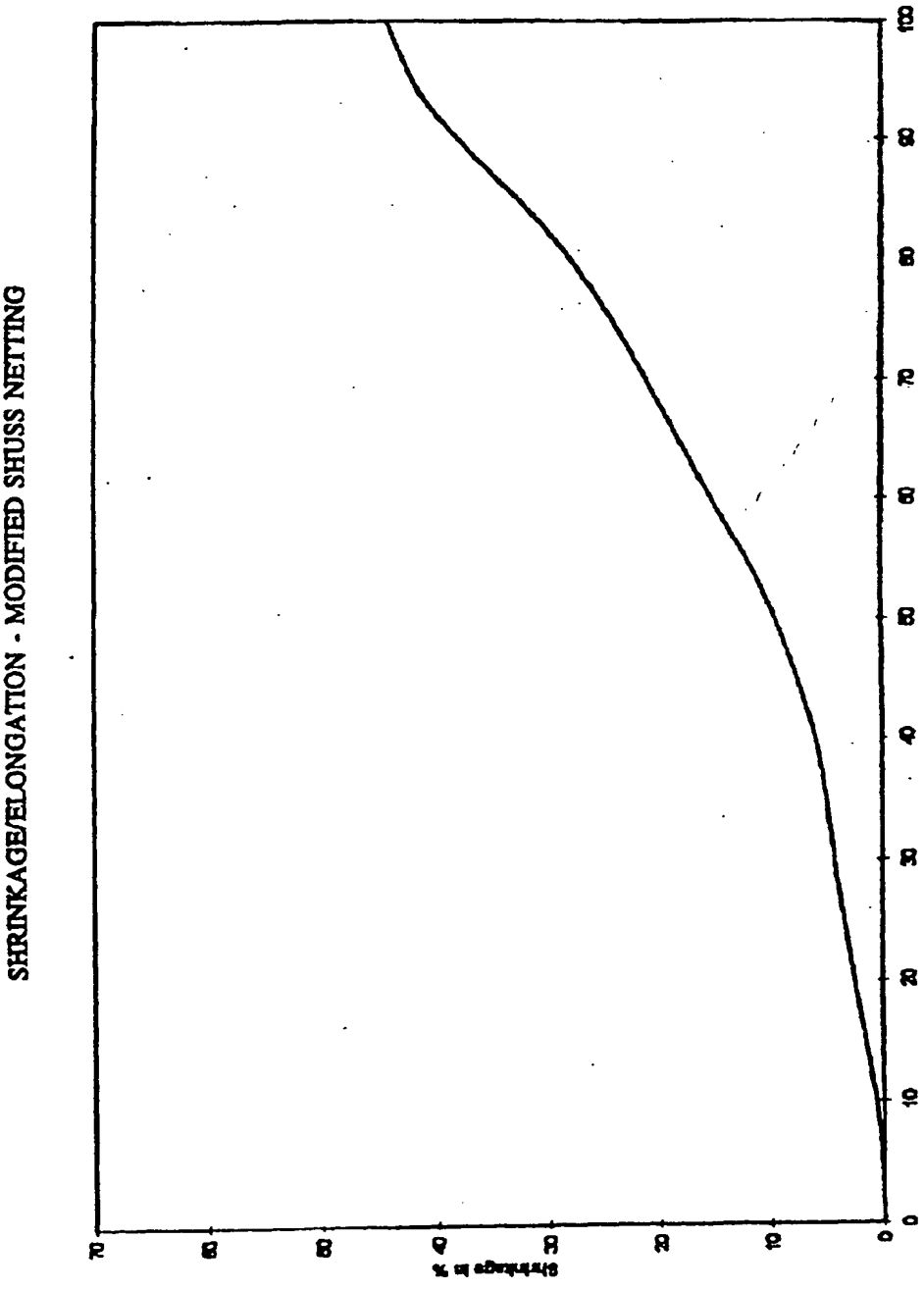

SHRINKAGE/ELONGATION - PRIOR ART NETTING
Elongation in %
0
10
20
30
40
50
60
70
80
90
100

FIG. 5


SHRINKAGE/ELONGATION - MODIFIED SHUSS NETTING
Elongation in %
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10
20
30
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50
60
70
80
90
100

FIG. 6

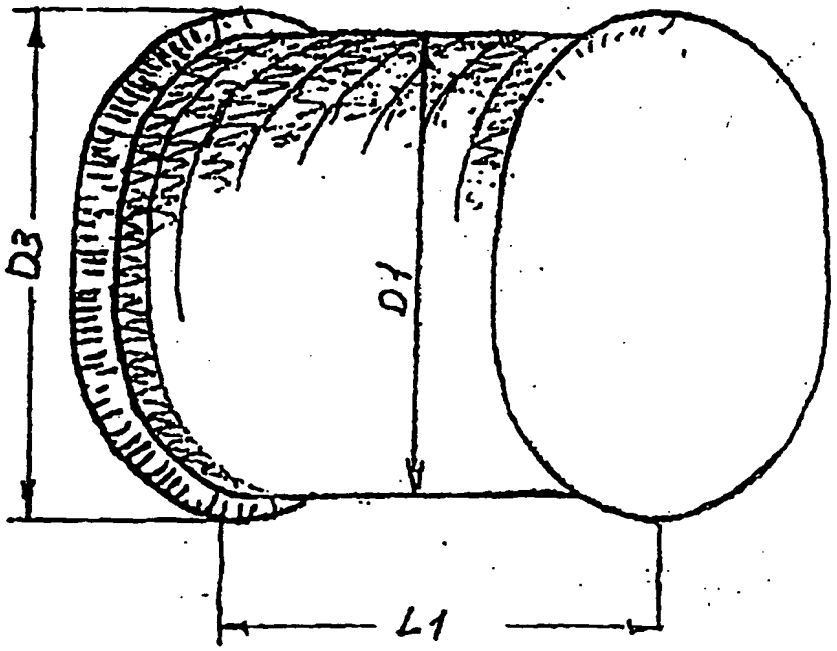

FIG. 7

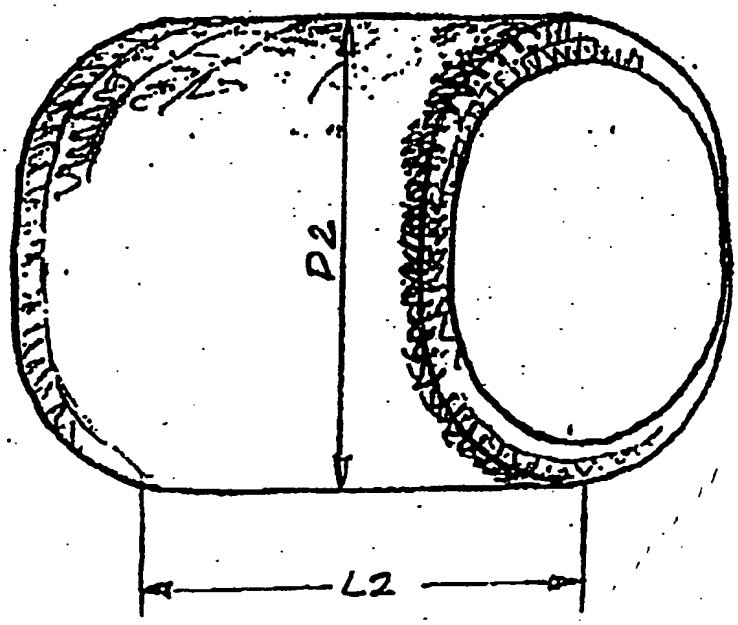

Fig. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 01 8522

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 43 01 231 A (OLBO TEXTILWERKE GMBH) 21 July 1994 (1994-07-21)		D04B27/10
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 October 2003	Van Gelder, P

CATEGORY OF CITED DOCUMENTS

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14-10-2003

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